Academic Content Standards

Note: These are the same for all eight clusters

- **Language Arts Content Standards**

1. **Reading and Responding**	Students will read and respond in individual, literal, critical and evaluative ways to literary, informational and persuasive texts.
2. **Producing Texts**	Students will produce written, oral and visual texts to express, develop and substantiate ideas and experiences.
3. **Applying English Language Conventions**	Students will apply the conventions of standard English in oral and written communication.
4. **Exploring and Responding to Texts**	Students will use the language arts to explore and respond to classical and contemporary texts from many cultures and literary periods.

- **Mathematics Content Standards**

1. **Number Sense**	Students will use numbers to count, measure, compare, order, scale, locate and label, and use a variety of numerical representations to present, interpret, communicate and connect various kinds of numerical information.
2. **Operations**	Students will add, subtract, multiply and divide with whole numbers, fractions, decimals and integers, and develop strategies for selecting the appropriate computational and operational methods for solving problems.
3. **Estimation and Approximation**	Students will make estimates and approximations, and judge the reasonableness of results.
4. **Ratios, Proportions and Percents**	Students will use ratios, proportions and percents to represent relationships between quantities and measures and solve problems involving ratios, proportions and percents.
5. **Measurement**	Students will make and use measurements in both customary and metric units to approximate, measure and compute length, area, volume, mass, temperature, angle and time.
6. **Spatial Relationships and Geometry**	Students will analyze and use spatial relationships and basic concepts of geometry to construct, draw, describe and compare geometric models and their transformations, and use geometric relationships and patterns to solve problems.
7. **Probability and Statistics**	Students will use basic concepts of probability and statistics to collect, organize, display and analyze data, simulate events and test hypotheses.
8. **Patterns**	Students will discover, analyze, describe, extend and create patterns, and use patterns to describe mathematical and other real-world phenomena.
9. **Algebra and Functions**	Students will use algebraic skills and concepts, including functions, to describe real-world phenomena symbolically and graphically, and to model quantitative change.
10. **Discrete Mathematics**	Students will use the concepts and processes of discrete mathematics to analyze and model a variety of real-world situations that involve recurring relationships, sequences, networks, combinations and permutations.

- **Science Content Standards**

1. **The Nature of Science**	Students will experience an inquiry-based learning environment in which they are free to ask questions, seek information and validate explanations in thoughtful and creative ways. Students also will understand that the processes, ways of knowing and conceptual foundations of science are interdependent and inextricably bound.
2. **History of Science**	Students will learn the evolution of scientific thought, how science has influenced culture and society, and how groups from many countries have contributed to the history of science.
3. **Living Things and Their Environments**	Students will understand that all organisms in the biosphere are linked to each other and to their physical environments by the transfer and transformation of matter and energy.
4. **Units of Structure and Function**	Students will understand that living things share common materials and structures which perform basic life functions.
5. **Relationships of Structure and Function**	Students will understand the classification and physiology of the great diversity of organisms and identify relationships of structure and function.
6. **Cycles of Life**	Students will recognize patterns and products of genetics and evolution.
7. **The Earth**	Students will understand the processes and forces that shape the structure and composition of the Earth.
8. **Water**	Students will understand the water cycle, including energy transfers, the distribution and characteristics of water, and its influences on human activity.
9. **The Earth's Atmosphere**	Students will understand the composition and structure of the atmosphere, including energy transfers, the nature of weather and climate, and the effect of the atmosphere on human activity.
10. **The Universe**	Students will understand that the Earth is a unique, dynamic member of the solar system, located in a galaxy within a changing universe.
11. **Structure of Matter**	Students will know the characteristic properties of matter and the relationship of these properties to structure and composition.
12. **Energy**	Students will know that energy is conserved, transferred, transformed and appears in different forms.
13. **Interaction of Matter and Energy**	Students will know that interactions between matter and energy can produce changes in a system, although the total quantities of matter and energy are unchanged
14. **Science and Technology**	Students will understand the relationships among mathematics, science and technology, and the way they affect and are affected by society.

Language Arts

By the end of Grade 12, students will develop proficiency, confidence and fluency in reading, writing, listening, speaking and viewing to meet the literacy demands of the 21st century.

Program Goals

As a result of education in Grades K-12, students will:

- read, write, speak, listen and view to construct meaning of written, visual and oral texts;
- read with understanding and respond thoughtfully to a variety of texts;
- write and speak English proficiently to communicate ideas clearly;
- create works using the language arts in visual, oral and written texts;
- choose and apply strategies that enhance the fluent and proficient use of language arts;
- understand and appreciate texts from many literary periods and cultures; and
- employ the language arts for lifelong learning, work and enjoyment.

Academic Content Standards

• Language Arts Content Standards

1.	**Reading and Responding**	Students will read and respond in individual, literal, critical and evaluative ways to literary, informational and persuasive texts.
2.	**Producing Texts**	Students will produce written, oral and visual texts to express, develop and substantiate ideas and experiences.
3.	**Applying English Language Conventions**	Students will apply the conventions of standard English in oral and written communication.
4.	**Exploring and Responding to Texts**	Students will use the language arts to explore and respond to classical and contemporary texts from many cultures and literary periods.

Content Standard I: Reading and Responding

Students will read and respond in individual, literal, critical and evaluative ways to literary, informational and persuasive texts.

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-12** will assure that students:

- ***describe the text by giving an initial reaction to the text and describing its general content and purpose;***

K-4: Students will describe the thoughts, opinions and questions that arise as they read, view or listen to a text and use relevant information from the text to summarize the content. **Example:** Students read *Alexander and the Terrible, Horrible, No Good, Very Bad Day*, share their ideas about what makes a bad day for them, and summarize what happened to the character in the book.	**5-8:** Students will describe the thoughts, opinions and questions that arise as they read, view or listen to a text, then identify the central idea, purpose or theme of a work. **Example:** Students read *Number the Stars*, generate questions for subsequent class discussion based on the book, and write a theme statement for the book after the class discussion.	**9-12:** Students will describe the thoughts, opinions and questions that arise as they read, view or listen to a text, demonstrate a basic understanding of the text, and identify inconsistencies and ambiguities. **Example:** Students read *Pride and Prejudice* and keep a journal to note their reactions to the relationships among the various characters and events in the story, and share examples of events from the novel that illustrate inconsistencies between characters' words and actions.

- ***interpret the text by using prior knowledge and experiences;***

K-4: Students will use what they know to identify or infer important characters, settings, themes, events, ideas, relationships or details within a work. **Example:** Students read *Encyclopedia Brown*, then use their experience to role play a scene in which Encyclopedia solves a problem for a character from another story.	**5-8:** Students will use what they know to identify or infer important characters, settings, themes, events, ideas, relationships or details within a work and draw conclusions about the author's purpose. **Example:** Students read *House on Mango Street*, discuss how the stories differ from their own life stories, then write a review focusing on the author's choices to post on their school's web site or bulletin board.	**9-12:** Students will examine the fit between the text and prior knowledge by reconciling differences, extracting clues or evidence, making inferences, drawing conclusions, predicting events, inferring motives and generalizing beyond the text. **Example:** Students read *How the Garcia Girls Lost their Accent*, then report their conclusions about characters' motivations in an essay and relate them to the motivations of characters in another novel.

K-12 PERFORMANCE STANDARDS

Content Standard I: Reading and Responding

- ***reflect on the text to make judgments about its meaning and quality;***

K-4: Students will analyze, elaborate on and respond critically to works.

Example: Students read *The Velveteen Rabbit*, list the character's traits, then tell their partners whether or not they like the story and why.

5-8: Students will evaluate explicit and implicit information within a work and compare and contrast the work to others with similar topics, themes, characters or problems.

Example: Students read and compare *Call of the Wild* and *Hatchet*, then debate which is a better piece of literature and why.

9-12: Students will demonstrate literary and aesthetic appreciation of the text, awareness of the author's style, understanding of textual features, and ability to challenge the text and think divergently.

Example: Students read Ralph Ellison's *Invisible Man,* then engage in a discussion of student-generated and teacher-presented questions based on the text about its literary merit.

- ***analyze text and task, set purpose and plan appropriate strategies for comprehending, interpreting and evaluating texts;***

K-4: Students will identify the type of text and use strategies (talking and writing, utilizing graphic organizers, drawing, listing, creating time lines, etc.) to accomplish a range of reading tasks.

Example: Students determine a chapter's structure (chronological, cause and effect, problem and solution, etc.) in a history book then read the first chapter and analyze its illustrations to create an educational board game.

5-8: Students will determine and use the structure of a written work to construct meaning and to select the best comprehension tool (retelling, using graphic organizers or story frames, writing to find meaning, etc.) for their purpose.

Example: Students complete a chart of what they already know and the questions they have about the topic in their science book ("KWL Chart"); use the illustrations, chapter headings, and charts and graphs to begin to answer their questions; then read the chapter to answer the remaining questions.

9-12: Students will adapt appropriate strategies to deepen initial understanding and go beyond the text to judge its literary quality.

Example: Students read *Lord of the Flies*, chart the conflicts among characters, then write an essay explaining what the novel reveals about the author's view of human nature, and compare that view to others of the same time period.

K-12 PERFORMANCE STANDARDS

- ***generate questions before, during and after reading, writing, listening and viewing;***

Content Standard I: Reading and Responding

K-4:	5-8:	9-12:
Students will ask and answer their own and each other's literal and inferential text-related questions. **Example:** Students brainstorm and respond to a list of questions that result from looking at the cover of a science book.	Students will ask and answer their own and each other's evaluative and interpretive questions. **Example:** Students read a classmate's original short story and periodically pause to list the questions they would like the author to answer about the effect the author's choices about characters, conflict, setting, theme, etc., had on the story.	Students will ask and answer their own and each other's text-related critical and analytical questions. **Example:** Students finish reading *Heart of Darkness* in preparation for an Advanced Placement examination, then create and answer a series of questions that respond to their understanding of a critic's analysis of the text.

- ***make and confirm or revise predictions;***

K-4:	5-8:	9-12:
Students will listen to, read and view texts, tell periodically how they think texts will turn out, then read to decide if their predictions prove accurate. **Example:** Students listen to a version of *Little Red Riding Hood*, say what they think will happen to the main character, listen to the rest of the story, and discuss their original predictions.	Students will predict as they read, listen to and view texts, then review the texts to assess the plausibility of their predictions. **Example:** Students read letters to Ann Landers, write their own replies and compare them to Ann Landers' replies.	Students will predict outcomes of the texts they read, listen to and view, then assess the validity of their predictions. **Example:** Students read the first section of *The Bet*, predict what actions each character will take, then read the rest of the story to assess their predictions.

K-12 PERFORMANCE STANDARDS

- ***use a variety of monitoring and self-correcting methods (skimming, scanning, reading ahead, re-reading, using resources, summarizing, retelling, readjusting speed);***

Content Standard I: Reading and Responding

K-4:	5-8:	9-12:
Students will practice using strategies to monitor and self-correct their comprehension as they read texts. **Example:** Students silently read the first few pages of *Riki,Tiki, Tavi*, tell a partner what they have read, then think aloud to describe the strategies they used to aid their comprehension and the methods they will use to proceed with the rest of the story.	Students will apply the variety of methods of monitoring and self-correcting to all texts read, listened to and viewed. **Example:** Students read *My Side of the Mountain* and identify the processes they used to understand the story.	Students will determine the most effective means of monitoring their comprehension, then apply those methods to texts read, listened to and viewed. **Example:** Students read Act I of *Macbeth*, pausing to reflect on their comprehension processes and to adjust where necessary.

- ***use the structure of narrative, expository, persuasive, poetic and visual text to interpret and extend meaning;***

K-4:	5-8:	9-12:
Students will identify the ways in which the various genre structures differ from each other. **Example:** Students list the differences in the story and play formats of *Three Little Pigs*.	Students will identify the features of various types of texts and apply their understanding to their examination of the texts. **Example:** Students discuss the literary elements of the ballad "The Highwayman."	Students will apply their understanding of textual features of each genre to their interpretations of that genre. **Example:** Students analyze the reasons for Shakespeare's inclusion of both poetry and prose in *Hamlet.*

- ***select and apply efficient and effective word recognition strategies, including contextual clues, picture clues, phonics and structural analysis;***

K-4:	5-8:	9-12:
Students will learn and use effectively the complete variety of word recognition strategies to aid in comprehension. **Example:** Students read books at their instructional level and unlock unknown words by attending to the beginning sound, finding clue words, looking for known chunks in the word, and determining if their word choice makes sense.	Students will apply all appropriate word recognition strategies to perfect reading fluency. **Example:** Students apply the contextual clue strategies their teacher has modeled as they read an encyclopedia entry in preparation for researching a country of their roots.	Students use word recognition strategies to perfect reading fluency in ever more sophisticated works. **Example:** Students orally read *Romeo and Juliet* and use the context and drawings to comprehend Elizabethan phrases.

K-12 PERFORMANCE STANDARDS

- ***use a variety of strategies to develop an extensive vocabulary;***

Content Standard I: Reading and Responding

K-4:	5-8:	9-12:
K-4: Students will read extensively, cluster, define, identify word parts and use other such strategies to build their comprehension skills. **Example:** Students develop and use a list of adjectives to write a descriptive essay about their best friend as part of a thematic unit on friendship.	**5-8:** Students will read extensively and apply a variety of vocabulary strategies to ensure advanced levels of comprehension. **Example:** Students cluster Latin derivatives used in the classification system before reading a relevant chapter in their science text.	**9-12:** Students will read extensively and apply the variety of vocabulary strategies to read ever more complex texts. **Example:** Students analyze the denotation and connotation of words used in a political campaign speech for the purpose of selecting powerful words to incorporate into their own speeches.

- ***identify and use main ideas and supporting details in informational texts or elements, such as key events, main characters and setting in narratives;***

K-4:	5-8:	9-12:
K-4: Students will retell and evaluate stories and select the most important facts from informational texts. **Example:** Students read an article in *Sports Illustrated for Children* and tell why one team was more prepared for the championship game than another.	**5-8:** Students will use the elements of narrative text to understand fiction and will use the elements of nonfiction to identify pertinent data. **Examples:** Students read the book, then view the video, *Indian in the Cupboard,* and compare the representation of character and setting in each.	**9-12:** Students will describe theme, symbolism, tone and other complex elements of fiction and identify point of view, manipulative language and other elements of bias in nonfiction materials. **Example:** Students read editorials in two newspapers and compare the positions and writers' strategies taken on a similar issue.

- ***make inferences about ideas implicit in narrative, expository, persuasive and poetic texts;***

K-4:	5-8:	9-12:
K-4: Students will support their inferences, orally and/or in writing, by referring to the materials read. **Example:** Students listen to a story being read on a *Reading Rainbow* video, then meet with a partner to tell each other why they think the protagonist made certain choices.	**5-8:** Students will identify the specific passages that support the ideas they take from both fiction and nonfiction. **Example:** After reading *Farewell to Manzanar,* students will discuss what the family's life had been like before the events described in the novel, supporting their inferences with references to the novel.	**9-12:** Students will use the literary elements of a text (theme, symbolism, imagery, conflict, etc.) to draw conclusions about a text. **Example:** Students meet in groups to share their interpretations of the symbolism in Maya Angelou's poem, "Caged Bird," then report the group's findings to the class.

K-12 PERFORMANCE STANDARDS

- ***understand that a single text may elicit a wide variety of responses; and***

Content Standard I: Reading and Responding

K-4: Students will generate a variety of responses based upon the experiences they have had.

Example: Students discuss how the events in a shared story remind them of events in other stories or in their lives.

5-8: Students will judge the plausibility of several interpretations of a text.

Example: Students view *The Monkey's Paw*, then listen to their classmates' reactions before writing their own play review.

9-12: Students will entertain, explore and defend multiple interpretations of all fiction and nonfiction they read.

Example: Students read and discuss classmates' and scholars' criticisms of *The Wasteland* and explain how their interpretation changed or did not change as a result of others' opinions.

- ***interact with others in creating, interpreting and evaluating written, oral and visual texts.***

K-4: Students will participate in a variety of cooperative group activities to apply collaborative skills (e.g., making eye contact, waiting turns, listening, taking others' ideas into account, explaining clearly, restating) to their reading, writing, listening and viewing.

Example: Students work together to contribute livelier words to the paragraphs on the board.

5-8: Students will interact in a variety of groupings to develop further the skills of collaboration to enhance their understanding of works read, written and viewed.

Example: Students watch a demonstration, read a how-to explanation, then work with science lab partners to write a report on dissecting a worm.

9-12: Students will apply collaborative skills to elaborate on concepts being addressed and to describe processes used in achieving results.

Example: Students meet with their research team to share their findings on the causes of the Holocaust and to describe the process they went through to reach their conclusions.

Content Standard 2: Producing Texts

Students will produce written, oral and visual texts to express, develop and substantiate ideas and experiences.

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-12** will assure that students:

- ***communicate effectively by determining the appropriate text structure on the basis of audience, purpose and point of view;***

K-4: Students will decide upon purpose, audience and point of view, then select from a group of text types, such as narrative, nonfiction and poetry, the most appropriate genre to convey their meaning.

Example: Students determine an issue to address; decide whether to address the issue in a story, poem or essay; write; then revise to have their writing make sense.

5-8: Students will determine purpose, point of view and audience, then use the appropriate features of persuasive, narrative, expository and poetic writing to achieve desired results.

Example: Students write a letter to the mayor persuading him or her to reevaluate his or her stand on recycling.

9-12: Students will select from the complete variety of text structures (essay, short story, poetry, academic essay, report, research paper, response to literature, documentary, etc.) the appropriate organizational pattern for addressing audience, purpose and point of view.

Example: Students revise selected pieces of their writing for inclusion in their end-of-year demonstration folders to present a range of their skills.

- ***communicate effectively in descriptive, narrative, expository and persuasive modes;***

K-4: Students will speak, write or draw in a variety of modes (narratives, "all-about" nonfiction pieces, poetry) to tell stories that their audience understands.

Example: Students write and illustrate their own fairy tales.

5-8: Students will plan, organize, create and revise visual, written and oral pieces at a level of elaboration appropriate for middle school.

Example: Students use the CMT rubric (focus, organization and elaboration) to revise their own narrative essays after conferring with peers and completing a self-analysis of the piece.

9-12: Students will identify and use effectively the salient features of all appropriate oral, visual and written discourse.

Example: Students analyze documentaries, then imitate them to create a presentation on the philosophies of Thoreau, Gandhi and Martin Luther King.

Content Standard 2: Producing Texts

K-12 PERFORMANCE STANDARDS

- ***gather, select, organize and analyze information from primary and secondary sources;***

K-4: Students will generate questions for gathering data from appropriate first-hand, visual and print sources and categorize the data to produce a product.

Example: Students track Internet explorers on the Silk Route through an Internet Program (such as Globalearn) as the explorers send back diaries and maps of their exploration.

5-8: Students will identify and use primary and secondary sources, paraphrase, elaborate on, and integrate information into a final product, e.g., I-Search paper, historical fiction, news article, research paper, documentary.

Example: Students examine newspaper articles and interview participants in a local event to create a documentary showing both sides of an issue.

9-12: Students will determine which primary and secondary sources are appropriate to the task (research paper, fiction, school newspaper, video) and will integrate and elaborate upon information effectively in the final product.

Example: Students examine two pieces of literature, consider the arguments about them presented in multiple critical essays, and compile all into a literary research paper.

- ***engage in a process of generating ideas, drafting, revising, editing and publishing or presenting; and***

K-4: Students will compose a piece of writing based on ideas generated through any of a variety of ways (writing, drawing, talking, webbing, listing, brainstorming), revise and proofread it, and present it to an audience.

Example: Students select a topic for study, use their notebooks to record data and organize information to create an essay.

5-8: Students will use and examine the effectiveness of multiple ways of generating ideas (brainstorming, listing, writing, talking, webbing, drawing), then compose, revise, edit and present a variety of products.

Example: Students complete a final draft of a poem then write a paragraph reflecting on their means of generating ideas and composing and revising the poem.

9-12: Students will identify and use the most effective process for them to create and present a written, oral or visual piece.

Example: Students write college application essays, identify the processes they have used to create them, then add the essays, if desired, to their school's web site.

Content Standard 2: Producing Texts

K-12 PERFORMANCE STANDARDS

- ***engage in writing, speaking and developing visual texts through frequent reflection, reevaluation and revision.***

K-4: Students will collect and examine, individually or with classmates, an array of their own stories and drawings, discuss the features they like, and say what they might do differently the next time.

Example: Students read favorite pieces of writing to their partners, who tell the writers what elements work and what questions they have about the piece of writing.

5-8: Students will keep and examine a variety of their products for the purposes of analyzing effectiveness and planning for ways of improving current and future work.

Example: Students choose a narrative written in the first person, change the point of view to the third person, and evaluate the strengths and weaknesses of each.

9-12: Students will maintain a multimedia portfolio which, along with providing a means for collecting their work, provides opportunities for student reflection and teacher/student dialogue regarding the students' creative processes.

Example: Students meet individually with their teacher with an example of a work that has been extensively revised, then consider the strengths and weaknesses of the writing and set goals.

Content Standard 3: Applying English Language Conventions

Students will apply the conventions of standard English language in oral and written communication.

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-12** will assure that students:

- ***proofread and edit for grammar, spelling, punctuation and capitalization;***

K-4: Students will develop proficiency in using capitalization, punctuation, usage and spelling skills appropriate for their grade level. **Example:** Grade 1 students work with their partners to capitalize months, days and holidays in narrative essays.	**5-8:** Students will demonstrate proficient use of capitalization, punctuation, usage and spelling skills appropriate for their grade level and individual goals and develop proficiency in the use of resources for proofreading and editing. **Example:** Students use a class-created editing rubric to proofread their persuasive letters to the principal regarding cafeteria conditions.	**9-12:** Students will demonstrate command of capitalization, punctuation, usage and spelling skills and utilize effective strategies and appropriate resources for proof-reading and editing. **Example:** Students work in teams to proofread team members' short stories for grammar, usage, punctuation, spelling and capitalization.

- ***speak and write using conventional patterns of syntax and diction;***

K-4: Students will use the spoken and written syntax and diction of the skilled writers and speakers with which they are made familiar. **Example:** Students reexamine a descriptive piece about a trip, then revise the writing to improve sentence formation and word choice.	**5-8:** Students will recognize the difference between the spoken and written syntax of standard and nonstandard writers and speakers of English and will choose the most appropriate words for the particular purpose. **Example:** Students use both standard English and dialect to create characters for a short story, then examine word choices for clarity and effect.	**9-12:** Students will use the spoken and written syntax made standard by television announcers and newspaper editorialists and will use the diction of skilled writers and orators. **Example:** Students watch a tape of personalities on the evening news (e.g., sportscaster, weather person, news anchor) and comment on the effectiveness of syntax and diction patterns.

Content Standard 3: Applying English Language Conventions

K-12 PERFORMANCE STANDARDS

- ***use variations of language appropriate to purpose, audience and task;***

K-4: Students will compare the language used by various speakers and writers and determine when the language is and is not fitting.

Example: Students examine language used in the book of poems *Honey, I Love* and determine when the language would be suitable to use on the playground with friends, in the classroom with teachers, and at home with family members.

5-8: Students will determine the variations of language used by speakers and writers in various contexts and will incorporate suitable language in their own writing and speaking.

Example: Students compare the difference in language used in letters to the editor and sports articles and determine the reasons for these differences.

9-12: Students will use the spoken and written syntax made standard by television announcers and newspaper editorialists and will use the diction of skilled writers and orators.

Example: Students watch a tape of personalities on the evening news (e.g., sportscaster, weather person, news anchor) and comment on the effectiveness of syntax and diction patterns.

- ***develop fluency and competency in the English language arts by using and building upon the strengths of the learner's language and culture; and***

K-4: Students will read, listen to and tell stories from a variety of cultures, including their own, and identify the similarities and differences in the way the language is used.

Example: Students read a collection of works by authors such as Robert Munsch and Mildred Taylor, and distinguish between the language used by the narrator and that used by characters in the text.

5-8: Students will examine the literature they read and the writing they create to articulate variations between the patterns used in their home language and culture and those used in the works they read and write.

Example: Students read poetry from a cross-section of authors (Gary Soto, Nikki Giovanni, Leslie Marmon Silko), then discuss the reasons for the variations in language.

9-12: Students will understand the forms of the English language as they vary across linguistic communities and will use the accepted features of standard English, and other linguistic communities, where appropriate, to create original written and oral works.

Example: Students newly arrived in the United States write poems in their native language and, using dictionaries, translate their poems into standard English.

Content Standard 3: Applying English Language Conventions

K-12 PERFORMANCE STANDARDS

- ***understand that an accepted practice in spoken and written language may change over time.***

K-4: Students will understand that words and expressions with which they are familiar have evolved and changed form over time.

Example: Students work with their teacher and peers to research the origins of compound words to recognize the evolution from hyphenated to an accepted compound word.

5-8: Students will explore works to identify words and conventions not currently used in everyday language.

Example: Students study the Gettysburg Address, noting uncommon phrases or words, and discuss the way Lincoln might have phrased the speech if he were writing it today.

9-12: Students will draw conclusions regarding the evolution of language and how it influences and reflects societal changes.

Example: Students read and compare the use of language in the *Plessy vs. Ferguson* decision with that of *Brown vs. Board of Education*.

Content Standard 4: Exploring and Responding to Texts

Students will use the language arts to explore and respond to classical and contemporary texts from many cultures and literary periods.

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-12** will assure that students:

- ***explore and respond to classic literary text that has shaped Western thought;***

K-4: Students will read/listen/view a variety of children's classics and talk about the ways life today is similar to the characters' lives.

Example: Students watch a play version of *The Tortoise and the Hare*, talk about the reasons the tortoise won the race, and discuss the possible kinds of classwork each of the characters would produce.

5-8: Students will read an array of literary classics and note themes, issues and ideas in the texts that are still influential in our present world.

Example: Students read Robert Frost's "The Road Not Taken" and write a response relating the poem to other texts that examine the consequences of one's choices.

9-12: Students will read the important classics of their grade level, determine the ways in which they have shaped Western culture, and analyze the reasons for their being considered "classics."

Example: Students read *Julius Caesar*, determine why Brutus betrays Caesar, discuss the reasons for a citizen's taking action against a leader, and argue for or against keeping the text in the curriculum.

- ***explore and respond to contemporary literature;***

K-4: Students will read, view and listen to a variety of recent children's literature and react to it in a variety of ways.

Example: Students keep and share a response journal in which they draw pictures and/or write in reaction to the characters and events in *Ira Sleeps Over*.

5-8: Students will read, view and listen to current works appropriate for their age level, then discuss the issues raised.

Example: Students keep and exchange journals in which, in preparation for reading *The Diary of a Young Girl*, by Anne Frank, they respond to articles written for the 50th anniversary of the Holocaust.

9-12: Students will read, view and listen to key works of contemporary literature and create responses that examine the works' principal elements.

Example: Students interview parents and friends to create a class list of best recent titles, take a field trip to a local book store to purchase books, then produce essays of literary criticism on their selected books.

Content Standard 4: Exploring and Responding to Texts

K-12 PERFORMANCE STANDARDS

- ***evaluate the merit of literary text on the basis of individual preferences and established standards;***

K-4: Students will declare their opinions about each of the works they read, listen to and view, then rate each according to such features as character development, conflict and theme.

Example: Students take turns reading aloud, then explain why they like or dislike a work and offer sufficient support for their reasons.

5-8: Students will examine the individual appeal of the works they read, listen to or view, and determine whether or not the author effectively used literary elements such as setting, point of view, irony, theme and conflict.

Example: Students listen to an audiotape of Martin Luther King's "I Have a Dream" speech and identify the features that appeal to them and rhetorical devices that make the speech effective.

9-12: Students will analyze the appeal of various works and determine their literary value.

Example: Students rank the works they have read, listened to and viewed during the year, first according to their own criteria, then according to traditional criteria of literary critics, and comment on any differences.

- ***examine the ways readers and writers are influenced by individual, social, cultural and historical context;***

K-4: Students discuss how the works they read and write are dependent upon factors such as the time, culture and experience of the reader and writers.

Example: Students participate in an author study and examine an author's biography to determine the various influences on the author's works.

5-8: Students understand that authors and readers are influenced by their times and experiences and identify those influences in the works they read, listen to and view.

Example: Students participate in literature circles, then create a chart to examine historical, social and cultural elements in Laura Ingall's historical fiction series, *Little House on the Prairie.*

9-12: Students will determine the various influences on authors and analyze the impact of those influences on the text.

Example: Students research colonial times, read sermons of the period, then determine which issues of the time shape the sermons and which issues arise from the author's own experience.

Content Standard 4: Exploring and Responding to Texts

K-12 PERFORMANCE STANDARDS

- ***recognize literary conventions and devices and understand how they convey meaning;***

K-4: Students will identify the literary conventions and devices used in such genres as folk tales, fairy tales, tall tales and poems, and tell how those conventions and devices help the reader understand the genre.

Example: Students read *Hailstones and Halibut Bones* and identify and explain the metaphors.

5-8: Students will explain how literary conventions such as romantic love in the Arthurian legends or heroism in historical fiction, and literary devices such as figures of speech, imagery and symbolism, contribute to their understanding of the text.

Example: Students explain how the extended metaphor in Langston Hughes's "Mother to Son" helps the reader understand the poem's theme.

9-12: Students will explain how all of the literary conventions and devices in a text or performance are used by an author to express tone, create mood and establish overall theme.

Example: Students analyze how diction, imagery, syntax and author's style establish the tone and mood of Wordsworth's sonnets.

- ***demonstrate an understanding that literature represents, recreates, shapes and explores human experience through language and imagination;***

K-4: Students will respond to literary works to determine various aspects that connect to their own lives.

Example: Students read *Charlotte's Web* and respond in their journals, connecting characters' attributes to human qualities.

5-8: Students will read works from different literary periods to determine how literature represents the human experience.

Example: Students read diaries from different periods and determine how literature represents experiences, noting the historical events which surrounded the diary keepers as they wrote.

9-12: Students will read, listen to and view literary texts and identify and explain the human experiences they convey.

Example: Students work in groups to write a script and present a play, connecting a literary experience to their lives.

- ***explore and respond to the aesthetic elements of literature, including spoken, visual and written texts;***

K-4: Students will note in their independent reading the qualities they like and dislike.

Example: Students respond in their reader-response journals, giving reasons for why they like or dislike *Grandpa's Face*.

5-8: Students will identify and discuss the aesthetic attributes of literary works.

Example: Students work in pairs to prepare a presentation which focuses on aesthetic elements in *My Brother, My Sister and I.*

9-12: Students will name and explain their aesthetic reactions to literary works.

Example: Students read and respond to *Joy Luck Club* and research a contemporary critic with a different point of view.

Content Standard 4: Exploring and Responding to Texts

K-12 PERFORMANCE STANDARDS

- ***use literature as a resource to explore ideas and decisions, as well as political and social issues;***

K-4: Students will determine the various ways people use literature to convey a message.

Example: Students study environmental issues, then research magazines, commercials and stories that relate to their study.

5-8: Students will read works with archetypal characters and themes to determine the political and social issues of concern to ancient peoples and the relationship to political and social issues of concern today.

Example: Students role play mythological figures to participate in a debate on a current issue.

9-12: Students will read classic and contemporary literature to determine political and social ideas which characterize those works.

Example: Students read *To Kill a Mockingbird* and *Things Fall Apart* and evaluate the political and social ideas expressed in the works.

- ***identify the unique and shared qualities of the voices, cultures and historical periods in literature; and***

K-4: Students will read a variety of works related to specific time periods to understand other cultural and historical periods.

Example: Students read literature about Native American peoples to understand those cultures.

5-8: Students will read classic and contemporary texts and conduct related research to understand the cultural influences of a time period on its works.

Example: Students read the novels *My Brother Sam is Dead* and *April Morning* and research historical texts to understand the cultural life portrayed in the novels.

9-12: Students will examine classical and contemporary literature to consider various cultural and historical influences on the authors.

Example: Students compare the novels *Red Badge of Courage* and *Gone with the Wind* and write a literary essay to show their understanding of the cultural and historical period portrayed.

- ***explore and respond to text representing both the literary tradition and the diversity of American cultural heritage.***

K-4: Students will read and respond to works by a variety of American and traditional authors.

Example: Students read various works and identify the conflicting accounts of Christopher Columbus' place in history.

5-8: Students will read and respond to works that reflect various American experiences and those of the milieu of traditional literature.

Example: Students read accounts written by women during the period of the westward expansion and respond in their journals to the topic of American diversity.

9-12: Students will read and respond to both classic and contemporary texts to examine themes central to the American experience and those portrayed in the range of traditional literature.

Example: Students read *Of Mice and Men* and explore issues related to the theme of "The American Dream."

Mathematics

By the end of Grade 12, students will apply proficiently a range of numerical, algebraic, geometric and statistical concepts and skills to formulate, analyze and solve real-world problems; to facilitate inquiry and the exploration of real-world phenomena; and to support continued development and appreciation of mathematics as a discipline.

Program Goals

As a result of education in Grades K-12, students will:

- communicate numerical, geometric, algebraic and statistical ideas orally and in written form with models, pictures, graphs and mathematical symbols, using paper and pencil, a variety of calculator displays, spreadsheets, graphing packages, word processing and other related computer software;
- use inductive and deductive reasoning to make, defend and evaluate conjectures and arguments, to justify assertions and verify tentative conclusions, and to solve mathematical problems;
- use mathematical skills and concepts to make and justify decisions and predictions, to identify patterns and trends, to pose questions from data and situations, and to formulate and solve problems;
- identify and use connections within mathematics to identify interrelationships and equivalent representations, to construct mathematical models, and to investigate and appreciate mathematical structure;
- use mathematical skills and concepts to describe and analyze data and measurements from other disciplines;
- select and use appropriate approaches and tools for solving computational, geometric and algebraic problems, including estimation, mental computation, guess and test, paper and pencil, calculators and computers with software for tabulating, charting, graphing, drawing and transforming data and images; and
- use mathematical skills and concepts with proficiency and confidence, and appreciate the power and utility of mathematics as a discipline and as a tool for solving problems.

- **Mathematics Content Standards**

1. **Number Sense**	Students will use numbers to count, measure, compare, order, scale, locate and label, and use a variety of numerical representations to present, interpret, communicate and connect various kinds of numerical information.
2. **Operations**	Students will add, subtract, multiply and divide with whole numbers, fractions, decimals and integers, and develop strategies for selecting the appropriate computational and operational methods for solving problems.
3. **Estimation and Approximation**	Students will make estimates and approximations, and judge the reasonableness of results.
4. **Ratios, Proportions and Percents**	Students will use ratios, proportions and percents to represent relationships between quantities and measures and solve problems involving ratios, proportions and percents.
5. **Measurement**	Students will make and use measurements in both customary and metric units to approximate, measure and compute length, area, volume, mass, temperature, angle and time.
6. **Spatial Relationships and Geometry**	Students will analyze and use spatial relationships and basic concepts of geometry to construct, draw, describe and compare geometric models and their transformations, and use geometric relationships and patterns to solve problems.
7. **Probability and Statistics**	Students will use basic concepts of probability and statistics to collect, organize, display and analyze data, simulate events and test hypotheses.
8. **Patterns**	Students will discover, analyze, describe, extend and create patterns, and use patterns to describe mathematical and other real-world phenomena.
9. **Algebra and Functions**	Students will use algebraic skills and concepts, including functions, to describe real-world phenomena symbolically and graphically, and to model quantitative change.
10. **Discrete Mathematics**	Students will use the concepts and processes of discrete mathematics to analyze and model a variety of real-world situations that involve recurring relationships, sequences, networks, combinations and permutations.

Content Standard 1: Number Sense

Students will use numbers to count, measure, compare, order, scale, locate and label, and use a variety of numerical representations to present, interpret, communicate and connect various kinds of numerical information.

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-4** will assure that students:	Educational experiences in **Grades 5-8** will assure that students:	Educational experiences in **Grades 9-12** will assure that students:
• use real-life experiences, physical materials and technology to construct meanings for whole numbers, commonly used fractions and decimals; • understand our numeration system by modeling, counting, grouping and using place-value concepts; • use numbers to count, as measures, labels and as indicators of location; • use models and pictures to demonstrate understanding of equivalent forms of numbers; • understand and use properties of numbers, including odd, even, ordinal and cardinal; and • develop a sense of magnitude of numbers by ordering and comparing whole numbers, commonly used fractions, decimals and money amounts.	• use real-life experiences, physical materials and technology to construct meanings for whole numbers, commonly used fractions, decimals and money amounts, and extend these understandings to construct meanings for integers, rational numbers, percents, exponents, roots, absolute value and scientific notation; • model, represent and use numbers in a variety of equivalent forms (integer, fraction, decimal, percent, exponential and scientific notation) as they arise from real-world situations; • use the equivalence of fractions, decimals and percents to select appropriate and efficient ways to write, order, compare, estimate and compute; • develop and use a sense of order and magnitude of fractions, decimals, integers, powers and roots; and • develop and apply number theory concepts (primes, factors, multiples and divisibility rules), as appropriate, in various real-world problem situations.	• use real-life experiences, physical materials and technology to construct meanings for rational and irrational numbers, including integers, percents and roots; • use number sense and the properties of various subsets of real numbers to solve real-world problems; • develop and use an intuitive sense of the magnitude of numbers (including very large and very small numbers) and relate them to place value and exponential forms; and • select an appropriate form to represent and use numerical data (integer, fraction, decimal, ratio, percent, exponential, scientific notation, irrational, complex) as they arise from real-world situations involving magnitude, order, measures, labels, locations and scales.

Content Standard 2: Operations

Students will add, subtract, multiply and divide with whole numbers, fractions, decimals and integers and develop strategies for selecting the appropriate computational and operational methods for solving problems.

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-4** will assure that students:	Educational experiences in **Grades 5-8** will assure that students:	Educational experiences in **Grades 9-12** will assure that students:
• develop meaning for the operations by modeling, comparing and discussing a variety of problem situations; • develop proficiency with basic addition, subtraction, multiplication and division facts through the use of a variety of strategies and contexts; • use informal language, mathematical language and symbols to relate problem situations to operations; • recognize that any one operation can be used to represent diverse problem situations, e.g., subtraction can be used in "take away," as well as comparison, situations; • construct, use and explain a variety of procedures for performing whole number calculations; and • understand and use relationships among operations, e.g., multiplication is repetitive addition; multiplication is the opposite of division.	• maintain proficiency with basic addition, subtraction, multiplication and division facts through the use of a variety of strategies and contexts; • develop, use and explain procedures for performing calculations with whole numbers, decimals, fractions and integers; • understand the concepts of powers and roots, and apply them in problem situations; • select and use an appropriate method for computing from among mental math, estimation, paper-and-pencil and calculator methods; and • use relationships among operations and properties of operations (associative, commutative and distributive) as well as order of operations and inverses to simplify computations.	• use arithmetic operations to solve problems encountered in everyday consumer situations; • apply and explain procedures for performing calculations with whole numbers, decimals, fractions and integers; • use appropriate methods for computing, including mental math, estimation, paper-and-pencil and calculator methods; • use field properties and the relationship between operations and their inverses to justify mathematical procedures; and • use absolute value, powers and roots; explore and use negative exponents on integers.

Content Standard 3: Estimation and Approximation

Students will make estimates and approximations, and judge the reasonableness of results.

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-4** will assure that students:	Educational experiences in **Grades 5-8** will assure that students:	Educational experiences in **Grades 9-12** will assure that students:
• explore, construct and use a variety of estimation strategies; • recognize when estimation is appropriate and understand the usefulness of an estimate as distinct from an exact answer; • use estimation to determine the reasonableness of an answer; • visually estimate length, area, volume and angle using various referents; and • apply estimation when working with quantities, measures and problems.	• develop, apply and explain a variety of estimation strategies in problem situations involving quantities and measures; • use estimation to predict outcomes and determine reasonableness of results; • recognize when estimation is appropriate and understand the usefulness of an estimate as distinct from an exact answer; and • determine whether a given estimate is an overestimate or underestimate.	• assess the reasonableness of answers to problems arrived at using pencil-and-paper techniques, mental math, formulas, calculators or computers; • develop, use and apply a variety of estimation strategies in problem situations; • make reasonable estimates of the values of formulas, functions and roots; and • recognize the limitations of estimation and assess the amount of error resulting from estimation.

Content Standard 4: Ratios, Proportions and Percents

Students will use ratios, proportions and percents to represent relationships between quantities and measures and solve problems involving ratios, proportions and percents.

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-4** will assure that students:	Educational experiences in **Grades 5-8** will assure that students:	Educational experiences in **Grades 9-12** will assure that students:
• describe simple ratios when comparing quantities.	• understand and use ratios, proportions and percents in a wide variety of situations; • develop, apply and explain methods for solving problems involving proportions and percents; • use and differentiate between fractional parts and ratios when comparing quantities; and • use dimensional analysis to identify and find equivalent rates.	• understand and explain the need for proportions and percents; • use ratios, proportions and percents to solve real-world problems; • use dimensional analysis and equivalent rates to solve problems; • describe direct and indirect variation and apply them to numerical, geometric and algebraic models and related problems; and • describe trigonometric ratios and apply them to measuring triangles.

Content Standard 5: Measurement

Students will make and use measurements in both customary and metric units to approximate, measure and compute length, area, volume, mass, temperature, angle and time.

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-4** will assure that students:	Educational experiences in **Grades 5-8** will assure that students:	Educational experiences in **Grades 9-12** will assure that students:
• use and describe measures of length, distance, capacity, mass, area, volume, time, temperature and angle; • compare and order objects according to some measurable attribute; • develop and use personal referents, such as fingers and arm spans, as estimates for standard units of measure; and • select and use appropriate standard and nonstandard units of measurement to solve problems.	• estimate, make and use measurements to describe and compare phenomena, and explore the structure and use of systems of measurement, including converting units within systems; • select and use appropriate measurement units and tools to make measurements to the degree of accuracy required by the situation; • solve problems involving the concept of, calculation of, and relationships among length, perimeter, area, volume, angle measure, capacity, weight, mass and temperature; and • develop and use formulas and procedures for solving measurement problems.	• extend, apply and formalize understandings of measurement, including strategies for determining perimeters, areas and volumes, and the dimensionality relationships among them; • describe and apply the effect of a change in length on the area and volume of an object; • choose appropriate tools and techniques to measure quantities to specified degrees of precision and accuracy; • use techniques of algebra, geometry and trigonometry to measure quantities indirectly; and • use and create scales and calibrations to solve problems involving measurement.

Content Standard 6: Spatial Relationships and Geometry

Students will analyze and use spatial relationships and basic concepts of geometry to construct, draw, describe and compare geometric models and their transformations, and use geometric relationships and patterns to solve problems.

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-4** will assure that students:	Educational experiences in **Grades 5-8** will assure that students:	Educational experiences in **Grades 9-12** will assure that students:
• describe, model, draw and classify shapes; • investigate and predict the results of combining, subdividing and changing shapes; • identify and use geometric shapes in various orientations, including rotations, reflections and translations; • use real-life experiences, concrete objects and technology to explore and understand properties of 2- and 3-dimensional geometric shapes; and • explore relationships among and properties of shapes, such as congruence, similarity and symmetry.	• investigate, explore and describe the geometry in nature and real-world applications; • identify, visualize, model, describe and compare properties of and relationships among 2- and 3-dimensional shapes; • describe and use fundamental concepts and properties of, and relationships among, points, lines, planes, angles and shapes, including incidence, parallelism, perpendicularity, congruence, similarity and the Pythagorean theorem; • construct, analyze and apply the effects of reflections, translations, rotations and dilations on various shapes; • relate 2- and 3-dimensional geometry using shadows, perspectives, projections and maps; and • solve real-world problems using geometric concepts.	• use transformations, coordinates and vectors and appropriate computer software to explore and develop an understanding of Euclidean geometry; • deduce properties of, and relationships among, figures from given assumptions; • develop an understanding of an axiomatic system through geometric investigations, making conjectures, formulating arguments and constructing proofs; • understand and analyze the geometry of three-dimensional shapes and their cross-sections; • solve real-world and mathematical problems using geometric models; and • interpret algebraic equations and inequalities geometrically, and describe geometric objects algebraically.

Content Standard 7: Probability and Statistics

Students will use basic concepts of probability and statistics to collect, organize, display and analyze data, simulate events and test hypotheses.

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-4** will assure that students:	Educational experiences in **Grades 5-8** will assure that students:	Educational experiences in **Grades 9-12** will assure that students:
• pose questions, make predictions and solve problems that involve collecting, organizing and analyzing data; • construct, read and interpret displays of data such as pictographs and bar and circle graphs; • make inferences and formulate hypotheses based on data; • generate and analyze data obtained from such chance devices as spinners and dice; • develop intuition about the probability of various real-world events; and • make predictions that are based on intuitive and experimental probabilities.	• make conjectures; design simulations and samplings; generate, collect, organize and analyze data; and represent the data in tables, charts, graphs and creative data displays; • make inferences and formulate and evaluate hypotheses and conclusions based on data from tables, charts and graphs; • describe the shape of the data using range, outliers, and measures of central tendency, including mean, median and mode; • select and construct appropriate graphical representations and measures of central tendency for sets of data; • determine the probability of simple and compound events; • model probabilistic situations using both simulations and theoretical methods; • make predictions that are based on experimental and theoretical probabilities; and • draw conclusions from data and identify fallacious arguments or claims.	• estimate probabilities, predict outcomes and test hypotheses using statistical techniques; • design a sampling experiment, interpret the data, and recognize the role of sampling in statistical claims; • use the law of large numbers to interpret data from a sample of a particular size; • select appropriate measures of central tendency, dispersion and correlation; • design and conduct a statistical experiment and interpret its results; • draw conclusions from data and identify fallacious arguments or claims; • use scatterplots and curve-fitting techniques to interpolate and predict from data; • use relative frequency and probability to represent and solve problems involving uncertainty; and • use simulations to estimate probabilities.

Content Standard 8: Patterns

Students will discover, analyze, describe, extend and create patterns and use patterns to describe mathematical and other real-world phenomena.

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-4** will assure that students:	Educational experiences in **Grades 5-8** will assure that students:	Educational experiences in **Grades 9-12** will assure that students:
• reproduce, extend, describe and create patterns and sequences using a variety of materials and attributes; • use tables and graphs to display pattern data and explore a variety of ways to write rules that describe patterns and relationships; and • develop and test generalizations based on observations of patterns and relationships.	• describe, analyze, create and extend a wide variety of patterns; • represent and describe mathematical relationships using tables, rules, simple equations and graphs; • use patterns and relationships to identify the nth term in a sequence; • construct and analyze tables and graphs to identify patterns and relationships; and • use patterns and relationships to represent and solve problems.	• identify, describe and generalize numerical and spatial patterns; • identify, describe and generalize patterns from data and identify and analyze patterns of change; and • predict and describe patterns produced by iterations, approximations, limits and fractals.

Content Standard 9: Algebra and Functions

Students will use algebraic skills and concepts, including functions, to describe real-world phenomena symbolically and graphically, and to model quantitative change.

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-4** will assure that students:	Educational experiences in **Grades 5-8** will assure that students:	Educational experiences in **Grades 9-12** will assure that students:
• represent numerical situations using variables, expressions, equations and inequalities; and • write and solve number sentences that describe real-life situations.	• use variables, expressions, equations and inequalities to describe and represent numerical situations; • use concrete materials, tables, graphs, verbal rules and symbolic expressions to represent situations and patterns; • analyze functional relationships to explain how a change in one quantity is associated with a change in another; • construct and interpret data points on number lines and the coordinate plane; and • solve simple linear equations using concrete, informal, graphical, tabular and formal methods.	• model and solve problems that involve varying quantities with variables, expressions, equations, inequalities, absolute values, vectors and matrices; • model real-world phenomena using polynomial, rational, trigonometric, logarithmic and exponential functions, noting restricted domains; • analyze the effect of parametric changes on the graphs of functions; • translate among and use tabular, symbolic and graphical representations of equations, inequalities and functions; • develop, explain, use and analyze procedures for operating on algebraic expressions and matrices; and • solve equations and inequalities using graphing calculators and computers as well as appropriate paper-and-pencil techniques.

Content Standard 10: Discrete Mathematics

Students will use the concepts and processes of discrete mathematics to analyze and model a variety of real-world situations that involve recurring relationships, sequences, networks, combinations and permutations.

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-4** will assure that students:	Educational experiences in **Grades 5-8** will assure that students:	Educational experiences in **Grades 9-12** will assure that students:
• classify data according to attributes; • solve simple counting problems; • use diagrams and models of simple networks that represent everyday situations; • identify and investigate sequences; and • follow, devise and describe practical algorithmic procedures.	• use systemic listing and counting strategies, including simple combinations and permutations; • use recursive processes, including iteration, to explore and solve problems; and • devise, describe and test algorithms for solving optimization problems.	• represent problem situations using finite graphs, matrices, sequences and recurrence relations; • develop, analyze, describe, invent and test algorithms; • define and use permutations, combinations, mathematical induction and recursion to solve combinatorial and algorithmic problems; and • understand and use appropriate strategies to solve optimization problems.

Science

By the end of Grade 12, students will know the basic concepts of, and the interrelationships among, biology, chemistry, physics, and earth (including ecology) and space sciences, and will be able to apply scientific skills, processes and methods of inquiry to real-world settings.

Program Goals

As a result of education in Grades K-12, students will:

- understand and apply basic concepts, principles and theories of biology, chemistry, physics, and earth (including ecology) and space sciences and their interrelationships;
- recognize and participate in scientific endeavors which are evidence-based and use inquiry skills that lead to a greater understanding of the world;
- identify and solve problems through scientific exploration, including the formulation of hypotheses, design of experiments, use of technology, analysis of data and drawing of conclusions;
- select and properly use appropriate laboratory technology, equipment and materials, including measuring and sensing devices;
- understand and use, when appropriate, existing and emerging technologies which have an effect on society and our quality of life, including personal, academic and work environments;
- analyze the possibilities and limits of science and technology in order to make and defend decisions about societal issues; and
- understand that the way in which scientific knowledge is formulated is crucial to the validity of that knowledge.

• Science Content Standards

1. **The Nature of Science**	Students will experience an inquiry-based learning environment in which they are free to ask questions, seek information and validate explanations in thoughtful and creative ways. Students also will understand that the processes, ways of knowing and conceptual foundations of science are interdependent and inextricably bound.
2. **History of Science**	Students will learn the evolution of scientific thought, how science has influenced culture and society, and how groups from many countries have contributed to the history of science.
3. **Living Things and Their Environments**	Students will understand that all organisms in the biosphere are linked to each other and to their physical environments by the transfer and transformation of matter and energy.
4. **Units of Structure and Function**	Students will understand that living things share common materials and structures which perform basic life functions.
5. **Relationships of Structure and Function**	Students will understand the classification and physiology of the great diversity of organisms and identify relationships of structure and function.
6. **Cycles of Life**	Students will recognize patterns and products of genetics and evolution.
7. **The Earth**	Students will understand the processes and forces that shape the structure and composition of the Earth.
8. **Water**	Students will understand the water cycle, including energy transfers, the distribution and characteristics of water, and its influences on human activity.
9. **The Earth's Atmosphere**	Students will understand the composition and structure of the atmosphere, including energy transfers, the nature of weather and climate, and the effect of the atmosphere on human activity.
10. **The Universe**	Students will understand that the Earth is a unique, dynamic member of the solar system, located in a galaxy within a changing universe.
11. **Structure of Matter**	Students will know the characteristic properties of matter and the relationship of these properties to structure and composition.
12. **Energy**	Students will know that energy is conserved, transferred, transformed and appears in different forms.
13. **Interaction of Matter and Energy**	Students will know that interactions between matter and energy can produce changes in a system, although the total quantities of matter and energy are unchanged
14. **Science and Technology**	Students will understand the relationships among mathematics, science and technology, and the way they affect and are affected by society.

Content Standard 1: The Nature of Science

Students will experience an inquiry-based learning environment in which they are free to ask questions, seek information and validate explanations in thoughtful and creative ways. Students also will understand that the processes, ways of knowing and conceptual foundations of science are interdependent and inextricably bound.

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-4** will assure that students:	Educational experiences in **Grades 5-8** will assure that students:	Educational experiences in **Grades 9-12** will assure that students:
• recognize (in Grades K-2) that when a scientific investigation is done in the same way in different places or when repeated many times, the investigation generally has the same results; • raise questions (in Grades K-2) about their surroundings and seek answers by making careful observations and trying things out; • recognize (in Grades K-2) that tools such as thermometers, magnifiers, rulers or balances often give more information than can be obtained by making observations without them; • describe things as accurately as possible (in Grades K-2) because careful, complete observations enable people to compare their observations with those of others; • use their senses (in Grades K-2), i.e., sight, taste, sound, touch, smell, to make observations about the natural world and discuss their findings; *(continued)*	• conduct scientific investigations which generally involve the collection of relevant evidence, the use of logical reasoning and creativity in devising hypotheses and explanations to make sense of the evidence; • identify and control variables in experiments; • evaluate the strengths and weaknesses of claims, arguments or data; • recognize that a variety of experimental designs and strategies can be developed to answer the same question; • use appropriate technology as a tool in problem solving; • accept the open-ended-ness of scientific inquiry and that scientific findings are not always definite or complete; and • use scientific knowledge and ways of thinking in personal decision making.	• gather and synthesize information concerning a problem; • generate and revise hypotheses based upon empirical data and the requirements of logical reasoning; • interpret the results of experimentation using statistical reasoning; • critique scientific experiments or research by seeking out possible sources of bias in the design and analysis of data; • suggest alternative ways of explaining data and criticize arguments in which data, explanations or conclusions are represented as the only ones worthy of consideration; and • prepare and present oral and written scientific reports that communicate in a logical sequence the process, results and validity of scientific experiments and research.

Content Standard 1: The Nature of Science

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-4** will assure that students:

- are open-minded and willing to modify opinions based upon evidence;
- design and conduct (both in groups and individually) simple experiments, keep accurate records of their findings, and communicate their findings to others using graphs, charts, maps, and oral and written reports;
- use evidence and logical reasoning as a basis for decision making;
- recognize that scientists' explanations about what happens in the world come partly from what they observe and partly from what they believe;
- recognize that sometimes scientists have different explanations for the same set of observations, which usually leads to additional observations to resolve the differences; and
- recognize that measuring instruments can be used to gather accurate information for making scientific comparisons of objects and events and for designing and constructing things that will work properly.

Content Standard 2: History of Science

Students will learn the evolution of scientific thought, how science has influenced culture and society, and how groups from many countries have contributed to the history of science.

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-4** will assure that students:	Educational experiences in **Grades 5-8** will assure that students:	Educational experiences in **Grades 9-12** will assure that students:
• recognize (in Grades K-2) that science is an adventure that people everywhere can take part in, as they have for many centuries; • recognize (in Grades K-2) that scientists usually work in groups, but important discoveries often have been made by individuals; • understand (in Grades K-2) that scientists study different things because they have different interests; • recognize that, although men and women doing scientific inquiry have learned much about the objects, events and phenomena in nature, there is still much more to be understood; • recognize that scientific ideas have changed over time; • understand that scientific investigations often raise questions which lead to new investigations; • recognize that a knowledge of the history of science can help scientists decide what needs to be studied next; and • understand that new technologies (a new instrument or device) allow scientists to conduct investigations that were not previously possible.	• recognize important contributions to the advancement of science, mathematics and technology that have been made by men and women in different cultures at different times; • understand that scientific discoveries are influenced by technological demands, competition, controversy, world events, personalities and societal issues; • recognize that, throughout history, scientists and engineers have been considered valued contributors to society; and • recognize that, throughout history, it has been difficult for scientific innovators to break through the preconceptions of their time to reach conclusions which today seem obvious.	• recognize that many Western as well as non-Western cultures (e.g., Egyptian, Chinese, Hindu, Arabic, Mayan) have developed scientific ideas and solved human problems through technology; • recognize that changes in science usually occur as small modifications in existing knowledge and result in incremental advances in our understanding of the world and our ability to meet human needs and aspirations; • recognize that occasionally there are advances in science and technology that have important and long-lasting effects on science and society (e.g., the Copernican revolution; plate tectonics; biological evolution; germ theory; industrial revolution; technological revolution); and • recognize that the study of scientific explanations throughout history demonstrates how scientific knowledge changes and evolves over time, building on earlier knowledge.

Content Standard 3: Living Things and Their Environments

Students will understand that all organisms in the biosphere are linked to each other and to their physical environments by the transfer and transformation of matter and energy.

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-4** will assure that students:	Educational experiences in **Grades 5-8** will assure that students:	Educational experiences in **Grades 9-12** will assure that students:
• describe (in Grades K-2) the basic needs of organisms (e.g., food, water, air, shelter and the need for sunlight by plants); • discuss (in Grades K-2) how organisms depend on other organisms and their environments for basic needs; • explain (in Grades K-2) how different organisms may interact within the ecosystem in a variety of ways; • describe how a variety of organisms, such as producers, consumers and decomposers, obtain their basic needs (e.g., food, water, air); • explain how organisms interact with other organisms in different environments (e.g., mutualism, parasitism, competition); and • explain that some source of energy is needed for all organisms to stay alive and grow.	• describe the roles of producers, consumers and decomposers in an ecosystem and provide specific examples of each; • explain the need for sunlight and other abiotic factors, such as water and air, in an ecosystem; • explain that while matter is recycled in an ecosystem, there is a one-way flow of energy in ecosystems; • explain that the number and variety of organisms and populations are dependent on the resources and physical factors of their environments; and • explain how both organisms and ecosystems can change if the physical conditions of an ecosystem change (e.g., a pond dries, a forest is destroyed by fire).	• explain chemical bonds and metabolic processes, such as photosynthesis and cellular respiration, as the use of energy by organisms; • explain that the distribution and abundance of organisms and populations in ecosystems are ultimately governed by the availability of matter and energy and the ability of the ecosystem to recycle organic materials; • describe the movement of matter and energy through different levels of organizations of living systems and show how matter and energy are transformed and conserved; • explain ways in which humans can minimize their impact on biomes; and • explain the differences between the Earth's major biomes in terms of both climate and organisms.

Content Standard 4: Units of Structure and Function

Students will understand that living things share common materials and structures which perform basic life functions.

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-4** will assure that students:	Educational experiences in **Grades 5-8** will assure that students:	Educational experiences in **Grades 9-12** will assure that students:

- list features (in Grades K-2) which distinguish living, nonliving and once-living things from one another;
- discuss (in Grades K-2) basic life functions, such as respiration, movement, elimination, responding to stimuli, taking in food, and reproduction;
- use instruments (in Grades K-2), such as magnifying glasses, to observe living and nonliving things more clearly;
- know that living things are composed of cells, which are the fundamental units of life;
- differentiate between unicellular and multicellular organisms;
- compare and group living and nonliving materials for similarities and differences;
- identify and describe basic cell structure; and
- recognize that all living things, from simple cells to multicellular organisms, share basic characteristics and requirements.

- identify similarities and differences that characterize different types of cells (e.g., plant, animal muscle, nerve, bone);
- recognize that basic life processes, such as photosynthesis and respiration, occur at the cellular level;
- recognize that tissues and organs in multicellular organisms are made of specialized groups of cells which work together to perform specific functions;
- understand that cells divide for growth, replacement, repair and reproduction; and
- understand that, while most living things are composed of cells, there are other things such as viruses that are difficult to identify as living or non-living.

- understand the role of the cell membrane in controlling materials entering and leaving the cell;
- understand that there are specialized structures in the cell used for energy capture and release;
- explain that the structure and function of cells depends on proteins, which are made of specific sequences of amino acids coded by the DNA, that are unique to each individual;
- know that cell behavior can be influenced by other cells, chemicals or other organisms;
- describe the processes and results of mitosis and meiosis;
- know that cells function in a narrow range of physical conditions, such as temperature and pH, to carry out life functions that help them maintain themselves (homeostasis);
- understand that continual solar energy input and the fixing of solar energy by photosynthetic organisms is necessary for most life;
- recognize that while viruses lack the standard cellular structure, they have the genetic material to invade living cells; and
- understand that the matter making up living things is the same matter found in the physical world.

Content Standard 5: Relationships of Structure and Function

Students will understand the classification and physiology of the great diversity of organisms and identify relationships of structure and function.

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-4** will assure that students:	Educational experiences in **Grades 5-8** will assure that students:	Educational experiences in **Grades 9-12** will assure that students:

- identify (in Grades K-2) the structures (e.g., stems, petals, legs, beaks) found in a variety of organisms;
- show (in Grades K-2) how living and nonliving things can be grouped using the characteristics they share;
- organize, compare and categorize (in Grades K-2) similarities and differences among organisms;
- describe (in Grades K-2) features that help organisms to survive in different environments (e.g., fur, coloration, thorns, webbed feet);
- employ different ways of classifying organisms into groups, using a variety of common features (e.g., presence of feathers, pointy vs. smooth leaves, whether they make their own food or get it from other sources);
- identify anatomical and behavioral adaptations which allow organisms to survive in specific environments;

(continued)

- describe the major distinctions among the kingdoms of living things (e.g., prokaryotic/eukaryotic, nucleated/non-nucleated, heterotrophic/autotrophic);
- describe ways in which internal and external structures, organ systems and body plans contribute to organisms being able to carry out life functions or processes (e.g., reproduction, response to stimuli, production and/or digestion of food, and production of energy, circulation, excretion, homeostasis);
- describe and analyze ways in which scientists determine the relatedness of organisms;
- explain the effects of disease on the inability of organisms to carry out essential life functions;
- understand the complementary nature of structure and function; and
- describe how different life functions (e.g., digestion, reproduction) are carried out by different organisms.
- understand that the present diversity of life is a result of natural selection and other evolutionary processes that have been at work for long periods of time;
- explain how representative organisms in different phyla are able to maintain a stable internal environment (homeostasis);
- describe why diversity in a species is important for its survival in a changing environment;
- explain how evolutionary relationships among organisms can be inferred from DNA and protein sequences;
- given a classification key, classify a given organism; and
- design a classification key which can be used by others to group organisms.

Content Standard 5: Relationships of Structure and Function

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-4** will assure that students:

- explain that the features of living things (e.g., trunks, tails, webbed feet) can be good indicators of their roles and places in an ecosystem;

- recognize that living things often have specialized sensory organs that help them gather information about their environments; and

- recognize that living things contain systems (such as digestion and respiration) that enable them to carry out basic life processes.

Content Standard 6: Cycles of Life

Students will recognize patterns and products of genetics and evolution.

K-12 PERFORMANCE STANDARDS		
Educational experiences in **Grades K-4** will assure that students:	Educational experiences in **Grades 5-8** will assure that students:	Educational experiences in **Grades 9-12** will assure that students:

- identify (in Grades K-2) external features of organisms that help them survive in different kinds of places;
- understand (in Grades K-2) that offspring tend to resemble their parents and that individuals of the same species have variations;
- recognize (in Grades K-2) that some organisms are alike in the way they look and in the things they do, and others are very different from one another;
- recognize (in Grades K-2) that many organisms once living on the Earth have disappeared;
- understand that organisms that are alive on the Earth today are both similar to and different from organisms that have disappeared;
- understand that, when living things reproduce, they transfer genetic information from one generation to the next;
- recognize that individuals of the same species differ in their characteristics, and sometimes these differences give individuals an advantage in surviving and reproducing; and
- describe the life cycle of familiar organisms (e.g., frog, butterfly, cat, dandelion).
- understand that each organism carries a set of instructions (genes) for specifying the components and functions of the organism;
- explain that differences between parents and offspring can accumulate in successive generations so that descendants are very different from their ancestors;
- recognize that individual organisms with certain traits are more likely than others to survive and have offspring;
- understand that the extinction of a species occurs when the environment changes and the species is not able to adapt to the changes;
- understand that the basic idea of biological evolution is that the Earth's present-day species developed from earlier species; and
- know that the many thousands of layers of sedimentary rock provide evidence for the history of the Earth and its changing life forms.
- recognize that changes in the types of species on Earth may have occurred either gradually or through sudden bursts of major change (punctuated equilibrium);
- compare and contrast Mendel's laws (segregation and independent assortment) of heredity;
- understand how fossil, anatomical, molecular and other observable forms of evidence provide support for the theory of natural selection;
- explain that preservation of the Earth's biological diversity is critical to the future of human beings and other living things;
- describe scientific theories for the origin of life and the evidence to support the theories;
- explain the differences between human beings and other primates;
- describe the biological history of human beings;
- compare and contrast different types of asexual and sexual reproduction;

(continued)

Content Standard 6: Cycles of Life

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades 9-12** will assure that students:

- explain how new heritable characteristics can result from new combinations of existing genes or from mutations of genes in reproductive cells; and

- understand that modern molecular biology allows scientists to analyze, isolate and alter genes, and this ability helps scientists in the analysis and treatment of certain diseases.

Content Standard 7: The Earth

Students will understand the processes and forces that shape the structure and composition of the Earth.

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-4** will assure that students:

- recognize (in Grades K-2) that rocks come in many sizes and shapes, and many have interesting textures, colors and patterns;
- identify (in Grades K-2) preserved traces of organisms, such as footprints, shells or imprints of leaves left in soft mud, clay or plaster;
- recognize (in Grades K-2) that the Earth has different land forms (e.g., mountains, hills, plains, rivers, beaches);
- observe (in Grades K-2) changes that happen to many Earth materials and land forms;
- list ways (in Grades K-2) that people use the Earth's resources (e.g., burning fuels to cook food and warm their houses, using materials for building, growing plants in soil);
- classify rocks according to a number of attributes, such as color, texture, layering, particle size and reactions with weak acids (e.g., vinegar);

(continued)

Educational experiences in **Grades 5-8** will assure that students:

- describe how sediments of sand and smaller particles (sometimes containing the remains of organisms) are buried and are cemented together by dissolved minerals and compacted to form solid rock again;
- explain how rock buried deep enough may be reformed by pressure and heat into different kinds of rocks and minerals;
- recognize that some useful minerals are scarce and some exist in great quantities, but the ability to recover them is just as important as their abundance;
- recognize that the movement of heat and materials within the Earth causes earthquakes and volcanic eruptions;
- describe the formation and movement of glaciers;
- use maps (e.g., topographic, hydrographic, highway) to identify land features and their locations;

(continued)

Educational experiences in **Grades 9-12** will assure that students:

- illustrate how the formation, weathering, sedimentation and reformation of rock constitute a continuing "rock cycle;"
- explain that the lithosphere consists of separate plates that ride on a denser, hot, gradually deformable layer of the Earth that releases energy and brings new materials to the Earth's surface;
- explain that plate tectonics is supported by geophysical, structural and paleontological evidence;
- describe how geological time can be determined using evidence from fossils, rock sequences and radiometric dating;
- interpret geological features within the community and state (e.g., road cuts, rivers, shorelines);
- explain interactions between the Earth's lithosphere, hydrosphere, atmosphere and biosphere; and
- analyze the costs, benefits, alternatives and consequences of natural resource exploration, development and consumption.

Content Standard 7: The Earth

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-4** will assure that students:

Educational experiences in **Grades 5-8** will assure that students:

- describe how land forms can change as a result of geological activities such as volcanic eruptions, earthquakes, floods, etc;
- explain that soil is made partly from weathered rock, partly from plant and animal remains, and also contains living organisms;
- identify ways in which evidence of ancient life has been preserved;
- explain how the energy in fossil fuels, such as oil, coal and gas, comes indirectly from the sun; and
- recognize that some energy sources cost more and cause more pollution than others.
- use maps (e.g., topographic, hydrographic, highway) to identify land features and their locations;
- recognize that some changes in the Earth's surface, such as earthquakes and volcanic eruptions, are abrupt, while other changes happen very slowly (e.g., uplift and wearing down of mountains); and
- explain how human activities (such as reducing the amount of forest cover, increasing the amount and variety of chemicals released into the atmosphere, and waste disposal) have altered the Earth's land, oceans and atmosphere.

Content Standard 8: Water

Students will understand the water cycle, including energy transfers, the distribution and characteristics of water, and its influences on human activity.

K-12 PERFORMANCE STANDARDS		
Educational experiences in **Grades K-4** will assure that students:	Educational experiences in **Grades 5-8** will assure that students:	Educational experiences in **Grades 9-12** will assure that students:

- recognize (in Grades K-2) that water can exist as a solid, liquid or gas and can be changed from one form to the other;
- recognize (in Grades K-2) that water on Earth exists in different forms (e.g., rain, snow, ice, surface water);
- recognize (in Grades K-2) that plants and animals need water to live;
- recognize that water can exist as a gas in the air and can reappear as a liquid, if cooled, or as a solid, if cooled below the freezing point of water;
- recognize that three-fourths of the Earth's surface is covered by water;
- identify major sources of water (e.g., oceans, glaciers, rivers, groundwater, atmosphere);
- recognize the importance and uses of water (e.g., drinking, washing, irrigating); and
- recognize that water is essential to life.

- recognize how the cycling of water in and out of the atmosphere plays an important role in determining climatic patterns and is responsible for constantly changing the phase and location of water;
- recognize that water falling to Earth flows over the surface as runoff and collects in ocean basins, rivers, lakes, icecaps and underground; and
- recognize that water stored underground (subsurface) and water stored above ground (surface) form a continuum, each supplying water to the other.

- recognize that the ocean is a complex system of important chemicals which cycle through other Earth systems over various periods of time;
- recognize that fresh water is limited in supply and can be depleted or polluted, becoming unavailable or unsuitable for life;
- explain interactions between water and other Earth systems (e.g., the biosphere, lithosphere and atmosphere);
- recognize that water is an erosional force that can rapidly and slowly change the landscape;
- describe how the oceans absorb and release heat energy that moderates the Earth's climate; and
- describe how the physical and chemical properties of water affect the environment and life.

Content Standard 9: The Earth's Atmosphere

Students will understand the composition and structure of the atmosphere, including energy transfers, the nature of weather and climate, and the effect of the atmosphere on human activity.

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-4** will assure that students:	Educational experiences in **Grades 5-8** will assure that students:	Educational experiences in **Grades 9-12** will assure that students:

- recognize (in Grades K-2) that air takes up space; air is colorless, tasteless and odorless; and you can only feel or hear air when it moves;
- know (in Grades K-2) that air contains water, that clouds are made of water and ice, and that precipitation comes from clouds;
- identify (in Grades K-2) simple weather instruments, such as thermometers and wind vanes;
- know (in Grades K-2) what seasons exist in New England;
- recognize (in Grades K-2) that the sun affects the weather on the Earth;
- know that the Earth is covered by an atmosphere that is divided into layers;
- recognize that air is a mixture of gases and can be compressed;
- recognize that there are different forms of precipitation and identify these forms;

(continued)

- describe air as a mixture of gases, including water vapor and other liquid and solid particles;
- recognize that air exerts pressure and expands and contracts in relation to temperature;
- explain wind as a function of the unequal heating of the Earth's surface;
- know that water changes form as a function of energy transfer;
- infer that water vapor condenses out of cooling air;
- create simple weather instruments to measure air pressure and humidity;
- identify sources of thunderstorms, tornadoes, hurricanes and winter storms, and describe their impact on human activities;
- infer that our atmosphere is dynamic and has patterns of weather systems;

(continued)

- describe heat and energy transfer as they are related to radiation, conduction and convection/advection;
- understand that, as water condenses, evaporates, melts or freezes, this heat energy transfer impacts weather phenomena;
- recognize and understand why rising air expands and decreases in temperature, while sinking air compresses and increases in temperature, and that this phenomenon has an impact on local weather and global climates;
- describe fronts as boundaries between air masses and recognize their association with different weather patterns;
- explain the patterns and distributions of different climates as a function of the Earth's physical features (e.g., oceans and mountains) and latitude;
- explain how the inclination of the Earth's axis affects the seasons, amount of daylight, and the altitude of the sun in the sky;

(continued)

Content Standard 9: The Earth's Atmosphere

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-4** will assure that students:	Educational experiences in **Grades 5-8** will assure that students:	Educational experiences in **Grades 9-12** will assure that students:

- compare forms of hazardous weather (including hurricanes, high winds, tornadoes, floods, blizzards, freezing rain and droughts) and its effects on humans and the land;
- identify instruments used by meteorologists and use simple weather instruments to measure air temperature and wind speed and direction;
- understand that there are patterns to weather as well as patterns to seasons;
- recognize that the Earth has different climates (e.g., arid, tropical, temperate and arctic); and
- describe the sun as the source of energy that causes weather to change.
- recognize that high pressure areas are usually associated with clear, dry weather and low pressure areas are often associated with precipitation; and
- describe and explain the reasons for the distribution of climates around the world.
- explain the impact on human activities of global phenomena, such as El Niño, global warming and the depletion of ozone in the atmosphere;
- discuss cyclone, hurricane, thunderstorm and tornado formation as both weather phenomena and vehicles for the transfer of heat energy; and
- create weather forecasts from data collected from various sources, including classroom instruments, television, newspapers, NOAA radio and information from sources via computer and modem.

Content Standard 10: The Universe

Students will understand that the Earth is a unique, dynamic member of the solar system, located in a galaxy within a changing universe.

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-4** will assure that students:	Educational experiences in **Grades 5-8** will assure that students:	Educational experiences in **Grades 9-12** will assure that students:
• recognize (in Grades K-2) that there are more stars in the sky than anyone can easily count, they are randomly distributed, and they vary in brightness or color; • understand (in Grades K-2) that the sun can be seen only in the daytime, but the moon can be seen sometimes at night and sometimes during the day; • know (in Grades K-2) that the sun, moon and stars all appear to move slowly across the sky; • describe (in Grades K-2) how the moon looks a little different every day, but looks the same about every four weeks; • describe (in Grades K-2) how the astronauts use spacecraft for travel and how some astronauts have even traveled to the moon and back; • know that the patterns of stars in the sky appear to stay the same, although they appear to move across the sky nightly, and different star patterns (constellations) can be seen in different seasons; *(continued)*	• understand that, to people living on the Earth, the 24- hour period of rotation of the Earth makes it seem as though the sun, moon, planets and stars are orbiting the Earth once a day; • recognize that the sun is a medium-sized star located near the edge of a disk-shaped galaxy of stars, that the universe contains many millions of galaxies, and that each galaxy contains many billions of stars; • describe the solar system as consisting of nine planets, different in size, composition and surface features, which all revolve around the sun in elliptical orbits; • understand that the moon's orbit around the Earth changes how much of the lighted portion of the moon can be seen from the Earth; • realize that the planets change their positions against the background of stars; • recognize that the mutual gravitational attraction of the Earth, moon and sun produces the ocean's tides; and *(continued)*	• understand that the stars differ from each other in size, temperature and age, but they appear to be made up of the same elements that are found on the Earth and appear to behave according to the same physical principles; • state that on the basis of scientific evidence, the universe is expanding and is estimated to be well over 15 billion years old; • describe how increasingly sophisticated technology is used to learn about the universe (e.g., visual, radio and X-ray telescopes); • understand that mathematical models and computer simulations are used in studying evidence from many sources in order to form a more comprehensive scientific account of the universe; • recognize that orbiting instruments, such as the Hubble telescope, provide information about the universe that could not be gathered from the Earth's surface; *(continued)*

Content Standard 10: The Universe

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-4** will assure that students:	Educational experiences in **Grades 5-8** will assure that students:	Educational experiences in **Grades 9-12** will assure that students:

- understand that telescopes magnify the appearance of the moon, the planets and stars;
- know that the Earth is one of several planets that orbit the sun, and that the moon orbits the Earth;
- know that stars are like the sun, some being smaller and some larger, but they are at such great distances that they look like points of light;
- recognize that the rotation of the Earth on its axis every 24 hours produces the night-and-day cycle; and
- recognize that information and photographs from orbiting spacecraft have added to our knowledge of the Earth and the universe.
- understand that many artificial satellites now orbit the Earth and are used for a variety of purposes.
- recognize that the solar system is part of a constantly changing universe in which stars are born, change and die; and
- understand that light from a star takes a very long time to reach the Earth and is actually a representation of its past location.

Content Standard 11: Structure of Matter

Students will know the characteristic properties of matter and the relationship of these properties to structure and composition.

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-4** will assure that students:

- describe (in Grades K-2) materials by their physical properties (e.g., color, size, shape, texture, flexibility);
- organize (in Grades K-2) objects in terms of the materials of which they are made (e.g., paper, cloth, clay);
- change the properties (in Grades K-2) of some materials (e.g., dissolve salt, evaporate water) and recognize that not all materials respond in the same ways;
- separate and classify objects (in Grades K-2) using one or more of the properties of the object;
- identify physical changes as changes in state or form;
- recognize that a chemical change occurs when substances interact to form new materials with properties that differ from those of the original substances;
- recognize that materials may be composed of parts too small to be seen;
- create and separate mixtures;

(continued)

Educational experiences in **Grades 5-8** will assure that students:

- use physical and chemical properties to classify and describe matter in terms of elements, compounds, mixtures, atoms and molecules;
- show that, while the quantity of matter is conserved, changes in matter can result in the formation of new materials;
- demonstrate that the kinetic molecular model of matter is useful in describing the structure and properties of solids, liquids and gases;
- recognize that all matter is made up atoms which are too small to be seen directly through the microscope, but that indirect evidence can be used to construct a useful model of the atom;
- recognize that atoms and molecules are perpetually in motion and that as the temperature of a substance increases, the average energy of motion also increases;
- show how features such as the temperature and acidity of a solution can influence reaction rates;

(continued)

Educational experiences in **Grades 9-12** will assure that students:

- describe the nature of atoms and how atoms combine to form molecules;
- explain how the chemical and physical properties of substances are related to their atomic and molecular structures;
- use the Periodic Table to predict common properties of elements;
- use chemical formulas and equations to obtain and communicate information about chemical changes;
- recognize that the ability of a reaction to occur and the extent to which it proceeds depends on the relative stability of the reactants compared to the products and the conditions under which the reaction occurs; and
- understand and apply mathematical concepts, including dimensional analysis, to explore and describe chemical changes.

Content Standard 11: Structure of Matter

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-4** will assure that students:

Educational experiences in **Grades 5-8** will assure that students:

- gather data to show that the mass of a whole object is equal to the sum of the masses of its parts;
- recognize that many substances can exist in different states (solid, liquid and gaseous) and some common substances, such as water, can be changed from one state to another by adding or removing heat from the material; and
- demonstrate that when substances change from one state to another, such as from a liquid to a solid, the total mass remains unchanged.
- give examples which show that changes in pressure, temperature or volume of a gas sample result in predictable changes in either or both of the other properties; and
- demonstrate that some properties (such as mass and volume) depend on the amount of material and some properties (such as density, melting point and boiling point) are independent of the amount of material.

Content Standard 12: Energy

Students will know that energy is conserved, transferred, transformed, and appears in different forms.

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-4** will assure that students:	Educational experiences in **Grades 5-8** will assure that students:	Educational experiences in **Grades 9-12** will assure that students:
• recognize (in Grades K-2) forms of energy (e.g., heat, light, sound) used every day; • recognize (in Grades K-2) that visible light contains the colors of the rainbow; • demonstrate (in Grades K-2) that sound can be produced by vibrating objects; • recognize (in Grades K-2) that energy can be used to bring about changes in matter (e.g., melt an ice cube); • demonstrate (in Grades K-2) that sound has different properties (e.g., high-low, loud-soft); • understand (in Grades K-2) that the sun's rays warm objects on the Earth; • describe various forms of energy, such as light, heat, electrical and chemical, and cite examples of the change of one form into another; • recognize that sounds can be varied by making changes to the objects emitting the sound (e.g., tautness of a string, length of a tube, medium through which the sound travels); *(continued)*	• recognize that energy can neither be created nor destroyed; • identify energy transformations that occur in various systems (e.g., biological, mechanical, geological) and recognize that heat is a by product of energy transformations; • demonstrate that heat can be transferred by convection, conduction and radiation; • recognize that energy exists in many forms (e.g., light, heat, chemical, electrical and mechanical) and that energy can be transformed from one form to another; • understand that all physical changes, including changes of state, require energy; • recognize that the sun produces energy in a range of wavelengths within the electromagnetic spectrum; and • compare and contrast different forms of energy in terms of their wavelengths on the electromagnetic spectrum.	• classify various forms of energy as either kinetic or potential; • recognize that heat energy is related to the disordered motion of atoms or molecules; • understand that the total amount of disorder in the universe is increasing; • explain that, although energy changes into different forms within a closed system, the total amount of energy remains unchanged, while the amount of useful energy is decreased; • describe the nature of different types of waves, how they are produced, and how they transfer energy; • understand that every object exerts a gravitational force on every other object; and • interpret the physical characteristics of sound, (including pitch and loudness) in terms of wave theory.

Content Standard 12: Energy

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-4** will assure that students:

- recognize that some materials conduct heat better than others, and that poor conductors (insulators) can reduce heat loss;
- give examples of ways energy consumption can be reduced;
- recognize that primary colors of light can be mixed to create other colors;
- demonstrate that light has a number of properties, such as color, brightness and direction of travel; and
- demonstrate that light can be absorbed, reflected, transmitted and bent using mirrors and lenses.

Content Standard 13: Interaction of Matter and Energy

Students will know that interactions between matter and energy can produce changes in a system, although the total quantities of matter and energy are unchanged.

K-12 PERFORMANCE STANDARDS		
Educational experiences in **Grades K-4** will assure that students:	Educational experiences in **Grades 5-8** will assure that students:	Educational experiences in **Grades 9-12** will assure that students:

- demonstrate (in Grades K-2) that the position or motion of objects can be changed by pushing or pulling;
- recognize (in Grades K-2) that the motion of objects can be compared by describing the general direction or type of motion (straight line, zigzag, vibrating or circular) and the relative speed;
- demonstrate (in Grades K-2) that magnets can move some objects without touching them;
- recognize (in Grades K-2) that magnets attract or repel each other and attract a few kinds of metals;
- demonstrate (in Grades K-2) that objects fall to the ground unless supported;
- give examples of some forces (e.g., magnetism, gravity) that can change the motion of objects without touching them;
- recognize that the motion of an object can be described as a change in the position of the object with respect to another object or background; and
- demonstrate that magnetic and electrostatic forces may both attract and repel.

- identify evidence that waves (e.g., light, sound, radiant) can transfer energy between two points;
- demonstrate that objects have inertia and momentum;
- recognize that the motion of one object can be described by measuring its position, direction and speed relative to another object;
- illustrate that changes in the speed and direction of an object are due to forces which have magnitude and direction;
- recognize that electric currents and magnets can exert a force on each other; and
- understand that a complete circuit is necessary in order for electric current to flow.

- explain how the interactions between various energy forms and matter can produce physical, chemical and nuclear transformations;
- observe, measure and represent mathematically the changes in the various energy forms taking place during the physical and chemical transformation of substances;
- describe how energy changes can be related to structural processes and modifications at the atomic and molecular levels;
- recognize that energy changes in atoms and molecules occur in fixed increments;
- recognize that energy and new particles are released when the nuclei of heavy atoms (e.g., uranium, plutonium) split;
- explain how radiation and matter interact in terms of the absorption and emission of energy by individual atoms, molecules and their aggregates;
- recognize that waves may interact with the materials they enter;

(continued)

Content Standard 13: Interaction of Matter and Energy

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades 9-12** will assure that students:

- recognize the types of radiation (e.g., light, radio, microwave, X-ray) which comprise the electromagnetic spectrum;

- understand the differences in the flow of electrical energy in conductors, semi-conductors and insulators; and

- recognize that accelerating electrical charges produce electromagnetic waves.

Content Standard 14: Science and Technology

Students will understand the relationships among mathematics, science and technology and the way they affect and are affected by society.

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-4** will assure that students:	Educational experiences in **Grades 5-8** will assure that students:	Educational experiences in **Grades 9-12** will assure that students:
• understand (in Grades K-2) that people create tools (e.g., shovel, hand lens, pencil), to help them to do things better and to do some things that otherwise could not be done at all; • identify (in Grades K-2) the contributions of science and technology to individuals and society; • recognize (in Grades K-2) that simple machines can be used to help people do work; • describe the role and use of technological devices in everyday life (e.g., microwave ovens, telephones, VCRs); • recognize possible negative consequences to people, other organisms or the environment, of technological solutions to specific problems; • understand that technology enables scientists and others to observe the world, e.g., things that are too small or too far away to be seen without technology, the motion of objects that are moving very rapidly or are hardly moving at all; *(continued)*	• investigate and describe human uses of renewable and nonrenewable resources (e.g., forests, fossil fuels); • explain interrelationships between science and technology (e.g., building a bridge, designing a better running shoe); • describe how the use of technology can contribute to the solution of an individual or community problem (e.g., using oxygenated fuels to help reduce air pollution); • recognize that science and technology cannot solve every problem faced by society; • describe how people use science and technology in their professions; • identify and analyze ways in which advances in science and technology have affected each other and society; • recognize that issues related to science, technology and society often are complex and involve risk/benefit trade-offs; *(continued)*	• analyze benefits and limit costs and consequences involved in using technology or resources (e.g., X-rays, agricultural chemicals, natural gas reserves); • analyze how the introduction of new technology has affected or could affect human activity (e.g., invention of the telescope, applications of modern telecommunications and bioengineering); • recognize that technological innovations (e.g., the automobile) may produce unanticipated problems of their own; • apply their knowledge and understanding of chemical and physical interactions to explain present and anticipated technologies (e.g., lasers, ultrasound, superconducting materials, photocopy machines); • recognize that science and technology often develop faster than society can comprehend their ethical implications; • explore the scientific and technological aspects of contemporary problems (e.g., issues related to nutrition, air quality, natural resources); *(continued)*

Content Standard 14: Science and Technology

K-12 PERFORMANCE STANDARDS

Educational experiences in **Grades K-4** will assure that students:	Educational experiences in **Grades 5-8** will assure that students:	Educational experiences in **Grades 9-12** will assure that students:

- identify alternative strategies to solve existing and potential environmental or technological problems;
- describe activities in which students can participate that can benefit their communities (e.g., recycling, water conservation);
- recognize that technology extends the ability of people to change the world (e.g., to cut, shape or put together materials; to move things from one place to another; to extend the reach of hands, voices, senses and minds);
- identify careers that use science and technology; and
- understand that there are different types of simple machines.

- understand that scientific advances may be misused and developed into technologies that have negative consequences;
- identify technological advances that are reported in the media; and
- understand that engineers, architects and others who engage in design and technology use scientific knowledge to solve practical problems.

- understand that science strives to understand the natural world and seeks explanations for natural phenomena, while technology seeks solutions to human problems and needs;
- understand that science, mathematics and technology are interdependent human endeavors with strengths and limitations; and
- recognize that technological problems often create a demand for new scientific knowledge, while new technologies make it possible for scientists to extend their research or to undertake entirely new lines of research.